REMARKS

By this amendment, claims 1-4, 6-14, 23-30, 33-42, 44-51, and 57-63 are pending in the application, of which claims 61 and 63 are being amended. Reconsideration of the present case in view of the amendments and remarks herein is respectfully requested.

The amendments to the claims are supported by the original Specification and claims as filed, and add no new subject matter. Amendments to claims 61 and 63 are cosmetic and correct informalities.

Objection to Claims 61 and 63

The Examiner objected to Claims 61 and 63 because of informalities relating to the use of two different sets of similarly lettered outlines, (a)-(d) and (a)-(c). These claims have been amended to use sets of differently lettered outlines, i.e. (a)-(d) and (1)-(3). Thus this objection is obviated.

103(a) Rejection of Claims 1-4, 11-14, 30, 33, 35, 37-39 and 61-63

The Examiner rejected claims 1-4, 11-14, 30, 33, 35, 37-39 and 61-63 under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,002,631 to Giapis et al. in view of U.S. Patent 5,608,526 to Piwonka-Corle (Piwonka-Corle). This rejection is respectfully traversed.

Claim 1

Claim 1 recites a substrate etching apparatus comprising, inter alia, "a signal analyzer to normalize the sample signal relative to the reference signal by mathematically operating on the sample signal to compensate for both (i) a fluctuation in the reflected radiation that originates from the radiation source and (ii) background radiation that is not from the radiation source."

The Examiner acknowledges that Giapis et al. does not teach "a signal analyzer adapted to normalize the sample signal relative to the reference signal by mathematically operating ..." The Examiner then relies on Piwonka-Corle to make up for this deficiency.

However, Piwonka-Corle also fails to teach a signal analyzer that normalizes the sample signal relative to the reference signal by mathematically operating on the sample single to compensate for a fluctuation originating from the radiation source and for background radiation. Piwonka-Corle teaches an ellipsometer to determine a thickness or refractive index of a sample (3). Radiation from a lamp (10) is split into a sample beam (9) and a reference beam (109). The sample beam (9) is reflected from the sample surface, whereas the reference beam does not reflect from the sample, but is directed directly to a spectrometer. Piwonka-Corle discloses that "processor 100 is programmed to normalize the reflectivity measured by sample beam 9 using the reference beam measurements from detector 273, to compensate for such effects as lamp intensity fluctuations and air currents" (column 15, lines 14-18). However, Piwonka-Corle does not disclose, inter alia, compensation for background radiation.

The Examiner's assertion "that Piwonka-Corle teaches background radiation compensation during signal processing is supported by Piwonka-Corle's very teaching of polychromatic collection and monochromatic analysis of said specific sample radiation signal" does not follow from the disclosure of Piwonka-Corle. That Piwonka-Corle discloses a detector comprising a photodiode array, "each photodiode in array 136 measur[ing] radiation of a different wavelength" (column 11, lines 60-61) does not mean that Piwonka-Corle is compensating for background radiation. Simply detecting multiple wavelengths of radiation, some of which may include background radiation, is not the same as compensating for that radiation during normalization. To compensate for background radiation during normalization is not inherent in the disclosure of Piwonka-Corle because, inter alia, the processor of Piwonka-Corle is not disclosed as being programmed to perform such compensation. In contrast, the

analyzer of Claim 1 specifically mathematically operates on the sample signal to compensate for background radiation during normalization of the sample signal.

Thus, the combination of Giapis et al. and Piwonka-Corle does not teach all of the limitations of Claim 1. Furthermore, it would not be obvious to arrive at the limitations of Claim 1 from these references given their deficiencies. Therefore, Claim 1 and those claims dependent therefrom are allowable over Giapis et al. in view of Piwonka-Corle.

Claim 30

Claim 30 recites a substrate etching apparatus comprising, inter alia, "one or more first fibers to transmit the reference radiation from the radiation source to the reference detector and one or more second fibers to transmit radiation from the radiation source to the chamber, the first and second fibers arranged to individually receive radiation from the same spatial area of the radiation source."

Giapis et al. discloses a "light source 162 can be coupled to the wafer by one branch of a bifurcated fiber bundle 166 and photoluminescent light from the wafer can be coupled by the other branch of bundle 166 to a monochromator 163" (column 4, lines 41-45). Giapis et al. does not teach one or more first fibers to transmit radiation from the radiation source to the reference detector. Giapis et al. furthermore is silent on the arrangement of the branches of the bifurcated fiber bundle in respect to the radiation source.

Piwonka-Corle does not make up for the deficiencies of Giapis et al. Instead, Piwonka-Corle teaches a single fiber into which illuminating radiation from a lamp enters, as shown in Figure 12. This is not the same as first and second fibers arranged to individually receive radiation from the same spatial area of the radiation source. Arranging the first and second fibers to individually receive radiation from the same spatial area allows the same source fluctuations to be seen, as discussed on page 10, lines 14 to lin 21, in the Specification of the Instant application.

Thus, the combination of Giapis et al. and Piwonka-Corle does not teach all of the limitations of Claim 30. Furthermore, it would not be obvious to arrive at the limitations of Claim 30 from these references given their deficiencies. Therefore, Claim 30 and those claims dependent therefrom are allowable over Giapis et al. in view of Piwonka-Corle.

Claim 38

Claim 38 recites a substrate etching apparatus comprising, inter alia, "a signal analyzer to normalize the sample signal relative to the reference signal by mathematically operating on the sample signal to compensate for both (i) the background radiation from the plasma and (ii) a fluctuation in the reflected radiation."

The Examiner acknowledges that Giapis et al. does not teach "a signal analyzer adapted to normalize the sample signal relative to the reference signal by mathematically operating ..." The Examiner then relies on Piwonka-Corle to make up for this deficiency.

However, Piwonka-Corle also fails to teach a signal analyzer that normalizes the sample signal relative to the reference signal by mathematically operating on the sample single to compensate for a fluctuation originating from the radiation source and for background radiation. Instead, Piwonka-Corle discloses that "processor 100 is programmed to normalize the reflectivity measured by sample beam 9 using the reference beam measurements from detector 273, to compensate for such effects as lamp intensity fluctuations and air currents" (column 15, lines 14-18). However, Piwonka-Corle does not disclose compensation for background radiation. The Examiner's assertion "that Piwonka-Corle teaches background radiation compensation during signal processing is supported by Piwonka-Corle's very teaching of polychromatic collection and monochromatic analysis of said specific sample radiation signal" does not follow from the disclosure of Piwonka-Corle. Simply detecting multiple wavelengths of radiation, some of which may includ background radiation, is

not the same as compensating for that background radiation during normalization. To compensate for background radiation is not inherent in the disclosure of Piwonka-Corle.

Thus, the combination of Giapis et al. and Piwonka-Corle does not teach all of the limitations of Claim 38. Furthermore, it would not be obvious to arrive at the limitations of Claim 38 from these references given their deficiencies. Therefore, Claim 38 and those claims dependent therefrom are allowable over Giapis et al. in view of Piwonka-Corle.

Claim 61

Claim 61, as amended, recites a substrate etching apparatus comprising, inter alia, "a signal analyzer adapted to normalize the sample signal to compensate for both (i) a fluctuation in the reflected radiation from the radiation source and (ii) background radiation that is not from the radiation source."

The Examiner acknowledges that Giapis et al. does not teach "a signal analyzer adapted to normalize the sample signal relative to the reference signal by mathematically operating ..." The Examiner then relies on Piwonka-Corle to make up for this deficiency.

However, Piwonka-Corle also fails to teach a signal analyzer that normalizes the sample signal relative to the reference signal by mathematically operating on the sample single to compensate for a fluctuation originating from the radiation source and for background radiation. Instead, Piwonka-Corle discloses that "processor 100 is programmed to normalize the reflectivity measured by sample beam 9 using the reference beam measurements from detector 273, to compensate for such effects as lamp intensity fluctuations and air currents" (column 15, lines 14-18). However, Piwonka-Corle does not disclose compensation for background radiation. The Examiner's assertion "that Piwonka-Corle teaches background radiation compensation during signal processing is supported by Piwonka-Corle's very teaching of polychromatic collection and monochromatic analysis of said sp cific sample

radiation signal" does not follow from the disclosure of Piwonka-Corle. Simply detecting multiple wavelengths of radiation, some of which may include background radiation, is not the same as compensating for that background radiation during normalization of the sample signal. To compensate for background radiation is not inherent in the disclosure of Piwonka-Corle.

Piwonka-Corle further fails to teach a signal analyzer that compensates by "(1) before the gas energizer energizes the etchant gas, measuring the sample and reference signals, (2) after the gas energizer energizes the etchant gas but before substantially etching has occurred, measuring the sample signal, and (3) during etching, measuring the sample and reference signals," as recited in the claim as amended. The Applicant respectfully disagrees with the Examiner's assertion that these limitations are "requirements of intended use" that "generally will not limit the scope of the claim." These limitations teach structural differences between the claimed invention and Piwonka-Corle. For example, as stated in the paragraph starting on line 4 of page 24 of the Specification, these limitations are part of an endpoint detection instruction set that comprises program code. As stated in this paragraph, "the normalization method ... is pre-programmed into the computer software," and "the compensation factor for determining background radiation is also written as program code." The endpoint instruction sets are part of a computer-readable program that is executed on a computer system under the direction of a chamber controller, as outlined in the paragraph starting on line 29 of page 17 of the Specification. Also, as stated in the paragraph starting on line 24 of page 13, the signal analyzer can be part of or the same thing as the computer system.

Thus, the combination of Giapis et al. and Piwonka-Corle does not teach all of the limitations of Claim 61. Furthermore, it would not be obvious to arrive at the limitations of Claim 61 from these references given their deficiencies. Therefore, Claim 61 and those claims dependent therefrom are allowable over Giapis et al. in view of Piwonka-Corle.

103(a) Rejection of Claims 6-10 and 23-29

The Examiner rejected claims 6-10 and 23-29 under 35 U.S.C. 103(a) as being unpatentable over Giapis et al. and Piwonka-Corle, in view of U.S. Patent 5,328,517 to Cates et al. This rejection is respectfully traversed.

Claim 1

Claim 1 is allowable over Giapis et al. and Piwonka-Corle for the reasons presented above.

Cates et al. fails to make up for the deficiencies of Giapis et al. and Piwonka-Corle. Instead, Cates et al. teaches that a processor may divide a signal from a detector, e.g. a photodiode array, by "a corresponding normalization signal obtained from a sample optical energy (18') of the light from [the optical energy] source (14)." (Col. 15, lines 61-65.) The outputs of detectors are normalized "for variations in the intensity of the output of optical energy source." (Col. 17, line 64 to col. 18, line 2.) However, this is not the same as "a signal analyzer to normalize the sample signal relative to the reference signal by mathematically operating on the sample signal to compensate for both (i) a fluctuation in the reflected radiation that originates from the radiation source and (ii) background radiation that is not from the radiation source," as recited in the claim. Cates et al. does not teach a signal analyzer that compensates for background radiation.

Thus, the combination of Giapis et al., Piwonka-Corle and Cates et al. does not teach all of the limitations of Claim 1. Furthermore, it would not be obvious to arrive at the limitations of Claim 1 from these references given their deficiencies. Therefore, Claim 1 and those claims dependent therefrom are allowable over Giapis et al. and Piwonka-Corle in view of Cates et al.

Claim 23

Claim 23 recites a substrate etching apparatus comprising, inter alia, "a signal analyzer to receive the sample signal and determine a corrected sample signal,

X_{nt}, using th expression $X_{nt} = X_t / \{Y_0 + C(Y_t - Y_0)\}$, where C is a correction factor, Y_0 is a reference signal at time 0, X_t is the sample signal at time t, and Y_t is the reference signal at time t."

The Examiner acknowledges that Giapis et al. and Piwonka-Corle "do not teach a signal analyzer that performs the normalization by assigning a specific mathematical algorithm for the normalization." The Examiner then relies on Cates et al. to make up for this deficiency.

However, Cates et al. fails to make up for this deficiency because Cates et al. does not teach "a signal analyzer to receive the sample signal and determine a corrected sample signal, X_{nt}, using the expression $X_{nt} = X_t / \{Y_0 + C(Y_t - Y_0)\}$." Instead, Cates et al. discloses a processor which generates a signal which is a weighted sum average, i.e. sums of quotients of the form described in column 18, lines 32-44. A processor that uses this mathematical form is different from a signal analyzer that uses the mathematical expression $X_{nt} = X_t / \{Y_0 + C(Y_t - Y_0)\}$ to determine a normalized sample signal that is compensated for source fluctuations and background radiation. Cates et al. does not teach, inter alia, the use of correction factor C and the specific formulation of the above mathematical expression. The correction factor C is explained on pages 15 and 16 of the Specification. The use of correction factor C is not suggested by Cates et al. The correction factor is important to provide compensation for, inter alia, background radiation.

Thus, the combination of Giapis et al., Piwonka-Corle and Cates et al. does not teach all of the limitations of Claim 23. Furthermore, it would not be obvious to arrive at the limitations of Claim 23 from these references given their deficiencies. Therefore, Claim 23 and those claims dependent therefrom are allowable over Giapis et al. and Piwonka-Corle in view of Cates et al.

103(a) Rejection of Claim 36

The Examiner rejected claim 36 under 35 U.S.C. 103(a) as being unpatentable over Giapis et al. and Piwonka-Corle, in view of Japanese Patent 01260304 to Taketora Saka. This rejection is respectfully traversed.

Claim 30

Claim 30 is allowable over Giapis et al. and Piwonka-Corle for the reasons given above.

Saka does not make up for the deficiencies of Giapis et al. and Piwonka-Corle. Instead, Saka is silent on the matter of optical fibers. Furthermore, Saka does not suggest or provide motivation for the use of first and second optical fibers arranged to individually receive radiation from the same spatial area of the radiation source.

Thus, claim 30 and the claims dependent therefrom, including claim 36, are allowable over Giapis et al. and Piwonka-Corle, in view of Saka.

103(a) Rejection of Claims 40-51 and 57-59

The Examiner rejected claims 40-51 and 57-59 under 35 U.S.C. 103(a) as being unpatentable over Giapis et al. in view of U.S. Patent 6,299,346 to Ish-Shalom et al. (Ish-Shalom et al.) This rejection is respectfully traversed.

Claims 40 and 57

The Examiner acknowledges that "Giapis [et al.] does not teach a feedback controller adapted to regulate a power level of the radiation source in relation to the detected intensity of the second radiation." The Examiner then relies on Ish-Shalom et al. to make up for these deficiencies.

However, Ish-Shalom et al. fails to make up for the deficiencies of Giapis et al. because Ish-Shalom et al. also does not teach, inter alia, "a feedback controller to regulate a power level of the radiation source in relation to" the detected intensity of the

second radiation (as recited in claim 40), or alternatively the reference signal (as recited in claim 57).

Instead, Ish-Shalom et al. teaches a control system that "provides incident radiation (40) intermittently by turning radiation source (28) on and off." This is different from the feedback controller of claim 40 because the control system does not regulate the radiation source power level "in relation to" a detected intensity of a second radiation or a reference signal. The "control system" turns the radiation source on and off at a predefined constant rate, whereas the recited "feedback controller" regulates the power level variably "in relation to the intensity" measured in real-time.

Thus, the combination of Giapis et al. and Ish-Shalom et al. does not teach all of the limitations of each of Claims 40 and 57. Furthermore, it would not be obvious to arrive at the limitations of Claims 40 and 57 from Giapis et al. and Ish-Shalom et al. given the deficiencies of these references. For example, the control system of Ish-Shalom et al. does not modulate the radiation source in relation to another measurable quantity, and neither Giapis et al. nor Ish-Shalom et al. provide motivation that a feedback controller might be used. Furthermore, the control system of Ish-Shalom et al. does not address the same problem as the feedback controller of Claims 40 and 57. Ish-Shalom et al. discloses the purpose of a shutter, which according to Ish-Shalom et al. is an alternative to turning the radiation source on and off, "is to alternately allow incident radiation 40 to reach back side 11a of wafer 10 and block incident radiation 40 from reaching back side 11a of wafer 10" (column 10, lines 51-54). Ish-Shalom et al. does not teach or suggest using the shutter, or turning the radiation source on and off, to stabilize the output of the light source. Giapis et al. also does not suggest regulating the radiation source power level, or using feedback control to do so, to eliminate lamp fluctuations. The Specification of the present Application, however, provides a clear description of the use of feedback control to stabilize the output of the radiation source, for example starting on line 19, page 16, through line 25, page 17. Furthermore, Giapis et al. and Ish-Shalom et al. provide no motivation or suggestion as to which signal to feed back. The Specification of the present

Application, however, provides a cl ar description that it is a reference signal from "a reference detector 63 which senses the radiation output or other property from the radiation source" (page 16, lines 25-26) that is fed back to regulate the radiation source power level.

Thus, claims 40 and 57, and the claims dependent therefrom, are allowable over Giapis et al. in view of Ish-Shalom et al.

Claim 44

Claim 44 is allowable over Giapis et al. because Giapis et al. fails to teach, inter alia, "a radiation modulator in a path of a radiation being transmitted from the radiation source to the chamber, the radiation modulator being adapted to receive the reference signal and control a property of the radiation in relation to the reference signal," as recited in the claim. Giapis et al. is silent on the matter of a radiation modulator adapted to control a property of the radiation in relation to the reference signal.

Ish-Shalom et al. does not make up for the deficiencies of Giapis et al. because Ish-Shalom et al. also fails to teach, inter alia, "a radiation modulator ... adapted to receive the reference signal and control a property of the radiation in relation to the reference signal." Instead, Ish-Shalom et al. teaches a shutter (23) to alternately allow incident radiation (40) from reaching a wafer (10) and block the incident radiation from reaching the wafer. However, the shutter does not alternately allow/block the radiation "in relation to" a reference signal that corresponds to a property of radiation detected from the radiation source. Instead, Ish-Shalom et al. alternately blocks of the radiation irrespective of any particular reference signal. Thus, the shutter of Ish-Shalom et al. is not a radiation modulator adapted to "control a property of the radiation in relation to the reference signal," as recited in claim 44. Furthermore, Ish-Shalom et al. does not teach, suggest or provide motivation for the shutter receiving a reference signal that relates to a detected property of radiation from the radiation source.

Thus, the combination of Giapis et al. and Ish-Shalom et al. does not teach all the limitations of Claim 44. Furthermore, it would not be obvious to arrive at the limitations of Claim 44 from these references given their deficiencies. Therefore, Claim 44 and those claims dependent therefrom are allowable over Giapis et al. and Ish-Shalom et al.

103(a) Rejection of Claim 60]

The Examiner rejected claim 60 under 35 U.S.C. 103(a) as being unpatentable over Giapis et al. and Ish-Shalom et al. in view of Piwonka-Corle. This rejection is respectfully traversed.

Claim 40

Claim 40 is allowable over Giapis et al. and Ish-Shalom et al. for the reasons given above.

Piwonka-Corle does not make up for the deficiencies of Giapis et al. and Ish-Shalom et al. because Piwonka-Corle does not teach or suggest using a feedback controller to regulate the power level of the radiation source based the intensity of a radiation detected from the radiation source.

Thus, claim 40 and the claims dependent therefrom, including claim 60, are allowable over Giapis et al. and Ish-Shalom et al. in view of Piwonka-Corle.

CONCLUSION

The above-discussed amendments are believed to place the present application in condition for allowance. Should the Examiner have any questions regarding the above remarks, the Examiner is requested to telephone Applicant's representative at the number listed below.

Respectfully submitted,

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